

INCH-POUND

MIL-DTL-38359B
10 November 2000
SUPERSEDING
MIL-C-38359A (USAF)
4 June 1985

DETAIL SPECIFICATION

CABLE, POWER, ELECTRICAL, AIRPORT LIGHTING, CROSS-LINKED, POLYETHYLENE (XLP)

This specification is approved for use by all Departments
and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers 8 AWG single conductor electric power cable of two voltage ranges intended primarily for use in airport lighting series circuits.

1.2 Classification. Cables are of the following classes, as specified:

Class 1 – 3,000 V rms
Class 2 – 5,000 V rms

1.2.1 Military part number. Part numbers are of the following form, as specified:

Class 1 – M38359-3K
Class 2 – M38359-5K

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications and standards. The following specifications and standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

Beneficial comments (recommendations, additions, deletions) and any pertinent data that may be of use in improving this document should be addressed to: Defense Logistics Agency, Defense Supply Center, Columbus (DSCC-VAI), P.O. Box 3990, Columbus, OH 43216-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A
DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

FSC 6145

SPECIFICATIONS

FEDERAL

A-A-59551 - Wire, Electrical, Copper (Uninsulated)

STANDARDS

MILITARY

MIL-STD-810 - Environmental Engineering Considerations and Laboratory Tests

(Unless otherwise indicated, copies of the above specifications and standards are available from the Document Automation and Production Service, DoDSSP, Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the applicable issues of the documents which have been adopted by the DoD are those listed in the specific issue of the DoDISS cited in the solicitation. Unless otherwise specified, the documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S19.81 (NEMA WC 3-92)	-	Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
ICEA S66.524 (NEMA WC 7-71)	-	Cross-Linked Thermal Setting-Polyethylene- Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

(Application for copies should be addressed to the National Electrical Manufacturers Association, 1300 North 17th Street, Suite 1847, Arlington, VA 22209, 703-841-3200)

2.4 Order of precedence. In event of a conflict between the text of this document and the references cited herein (except for related specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Qualification. Cables furnished under this specification shall be products which are authorized by the qualifying activity for listing on the applicable qualified products list at the time of award of contract (see 6.3).

3.2 Materials. The materials for the principal components of the cable shall be as specified herein. Prior approval to use substitute material must be obtained from the qualifying activity. When a definite material is not specified, a material shall be used that will enable the finished products to meet the performance requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guaranty of the acceptance of the finished product. All materials used in the manufacture of cables furnished to comply with this specification shall be of such quality and form that the finished product conforms to the requirements of this specification. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible, provided that the material meets operational and maintenance requirements and promotes economically advantageous life cycle costs. All materials used shall conform to the requirements specified herein.

3.3 Design and construction. The cable shall be designed and constructed for use in airport lighting systems. It shall be constructed for continuous outdoor service under all weather conditions while on the surface of the ground, buried directly in the ground, installed in conduit, or submerged in fresh or salt water. The voltage rating, high potential withstanding voltage, wire size, and average thickness of the insulation for the cables specified herein shall be as specified in table I.

TABLE I. Combined cable characteristics.

Characteristic	Class 1	Class 2
Voltage rating	3,000 V rms	5,000 V rms
High potential withstanding voltage	7,500 V rms (5 minutes)	11,000 V rms (5 minutes)
Insulation thickness (average)	.075 inch (1.91 mm)	.11 inch (2.79 mm)
Diameter:		
Minimum	.31 inch (7.87 mm)	.38 inch (9.65 mm)
Nominal	.32 inch (8.13 mm)	.39 inch (9.91 mm)
Maximum	.34 inch (8.64 mm)	.41 inch (10.41 mm)

3.3.1 Conductors. The conductor shall conform to A-A-59551, type C, number 8 AWG, class B, tin coated.

3.3.1.1 Splices. Splices in the conductor shall be such that each splice will not increase the diameter of the conductor. No splice shall be made in the conductor as a whole. Not more than one strand shall be spliced in any one foot of conductor.

3.3.1.2 Resistance. The resistance of the conductor of 1,000 feet of completed cable at +20 °C shall not be greater than .65 ohm.

3.3.1.3 Conductor shield. A semiconducting layer or tape shall be applied directly over the stranded conductor, over which the cable insulation shall be applied. The conductor shield shall have a minimum thickness of .005 inch (0.13 mm).

3.3.1.4 Marker threads. Nonhygroscopic-type marker threads shall be provided in the conductor strands or directly along the conductor for identification purposes. The color and number of threads used shall be identical with those used by the manufacturer on his other products.

3.3.2 Insulation. The insulation shall consist of a black cross-linked thermoplastic polyethylene (XLP) compound which meets the requirements for the insulation included in ICEA S66.524 and all the requirements specified herein. The insulation shall be applied tightly and concentrically about the conductor over the conductor shield and shall be free from pores, splinters, and other such defects.

3.3.2.1 Insulation thickness. The average thickness of the insulation shall be not less than that specified in table I. The minimum thickness at any point shall be not less than 90 percent of the thickness specified in table I. If the insulation is applied in more than one layer, the adjacent layers shall be molded into a homogeneous mass and the mass considered as a whole for all measurements and tests.

3.3.2.2 Insulation resistance. The measured insulation resistance (see 4.5.3) at 15.6 °C shall be not less than that calculated from the following formula:

$$R = K \log_{10} \frac{D}{d}$$

Where R = Megohms - 1000 feet

D = Outside diameter of insulation in inches

d = Diameter of uninsulated conductor in inches

K = Constant 25,000 for insulation specified herein

NOTE: If the temperature differs from 15.6 °C during the resistance measurement, correction shall be made by multiplying the calculated value of R by the coefficient corresponding to the temperatures during measurement. The coefficient for the insulation shall be that specified by the manufacturer. The temperature coefficient shall be determined in accordance with ICEA S19.81.

3.3.2.3 Joints. All joints made in the insulation shall be such that all parts affected in the process will be electrically and physically equal to the remainder of the insulation and shall conform to the thickness requirements specified herein.

3.3.2.4 Physical properties. The physical properties of the insulation shall be as follows:

a. Original physical requirements:

- (1) Tensile strength, initial, 1,800 lbf/in² minimum.
- (2) Elongation at rupture, 350 percent minimum.
- (3) Modulus at 200 percent elongation, 1,000 lbf/in² minimum.

b. Aging requirements:

- (1) After air oven test at a minimum of 150 °C for 168 hours:
 - (a) Tensile strength in percent of unaged value, 75 percent minimum.
 - (b) Elongation at rupture in percent of unaged value, 65 percent minimum.
- (2) After air pressure heat test for 42 hours at 80 lbs/in² and 127 °C:
 - (a) Tensile strength in percent of unaged value, 75 percent minimum.
 - (b) Elongation at rupture in percent of unaged value, 75 percent minimum.

3.3.2.5 Ozone resistance. The cable insulation shall be resistant to ozone attack.

3.3.2.6 Moisture absorption. The moisture absorption properties of the cable insulation shall be as follows:

Increase in capacitance:

1 to 14 days: 3 percent maximum

7 to 14 days: 1.5 percent maximum

3.3.2.7 Cold bend. The cable insulation shall not crack as a result of bending at a radius of 2.5 times the cable diameter when in an ambient temperature of -40 °C or less.

3.4 Performance.

3.4.1 High temperature. The cable shall be resistant to high temperatures encountered while in storage and under service conditions. When in an ambient temperature of 71 °C, a full reel of cable shall not suffer permanent set to any portion of the cable or show evidence of insulation deterioration.

3.5 Surface marking on cable. The manufacturer's name and contract number shall be legibly marked on the surface of all cable. The markings shall be of paint or ink applied at intervals not exceeding 10 feet. The markings shall be durable and not readily smeared during handling of the cable.

3.6 Workmanship. Workmanship shall be of the quality necessary to produce cable free from all defects which affect proper functioning in service. The exterior surface of the cable shall be smooth, uniform, and free from splinters, ridges, grooves, indentations, and protuberances visible to the naked eye.

3.7 Cable lengths. Except as specified in 3.7.1, cable shall be of one continuous 3,000-foot length, +10, -3 percent (see 6.2).

3.7.1 Allowable short lengths. Unless otherwise specified by the acquiring activity (see 6.2), short lengths may be supplied in accordance with the following schedule on orders of 100,000 feet and over:

- a. 85 percent or more of the order: 3,000-foot lengths.
- b. 10 percent or less of the order: 1,500-foot minimum lengths.
- c. 5 percent or less of the order: 1,000-foot minimum lengths.

For orders of less than 100,000 feet, all lengths shall be 3,000 feet +10, -3 percent.

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. Qualification inspection (see 4.3).
- b. Conformance inspection (see 4.4).

4.2 Inspection conditions. Unless otherwise specified (see 6.2), all inspections shall be conducted at a temperature of 25±10 °C.

4.3 Qualification inspection. Qualification inspection (see 6.2 and 6.3) shall be performed at a laboratory acceptable to the Government on sample units produced with equipment and procedures normally used in production. Cable supplied under the contract or purchase order shall be manufactured the same way as the sample tested and found satisfactory, except for changes previously approved by the Government.

4.3.1 Qualification sample. The qualification sample shall consist of a reel of cable or a 50-foot or longer coil. The sample shall be appropriately identified with the manufacturer's part number and such other information as required by the acquiring activity.

4.3.2 Qualification inspection. The qualification inspection shall consist of all the tests specified under 4.5.

4.3.3 Requirements cross-reference matrix. Table II provides a cross-reference matrix of Section 3 requirements tested or verified in the paragraphs below.

TABLE II. Requirements cross-reference matrix.

Requirement	Verification	Requirement	Verification
3.1	4.3	3.3.2.3	4.5.1, 4.5.3, and 4.5.3.1
3.3	4.5.1, 4.5.2	3.3.2.4	4.5.9
3.3.1	4.5.1	3.3.2.5	4.5.6
3.3.1.1	4.5.1	3.3.2.6	4.5.5
3.3.1.2	4.5.8	3.3.2.7	4.5.7
3.3.1.3	4.5.1	3.4.1	4.5.10
3.3.1.4	4.5.1	3.5	4.5.1
3.3.2	4.5.1	3.6	4.5.1
3.3.2.1	4.5.3.1	3.7	4.5.1
3.3.2.2	4.5.3	3.7.1	4.5.1

4.3.4 Retention of qualification and requalification. Periodic qualification reevaluations shall be made at 3-year intervals after the date of the letter of notification of the product's acceptability for qualification. Materials from current production shall be evaluated against the requirements of 4.4.1 and 4.4.2. Requalification procedures and data requirements shall be as specified by the procuring activity (see 6.2).

4.4 Conformance inspection. The acceptance tests shall consist of the following:

- a. Individual tests (see 4.4.1).
- b. Sampling plan and tests (see 4.4.2).

4.4.1 Individual tests. Each reel of finished cable shall be subjected to the following tests as described under 4.5:

- a. Inspection of product (see 4.5.1).
- b. High potential withstanding voltage test (see 4.5.2).
- c. Insulation resistance test (see 4.5.3).
- d. Continuity test (see 4.5.4).

4.4.2 Sampling plan and tests. Unless otherwise specified (see 6.2), the following tests shall be conducted at least once in every 30-day period, starting at the beginning of production and continuing until completion of the order:

- a. Moisture absorption test (see 4.5.5).
- b. Ozone resistance test (see 4.5.6).
- c. Cold bend test (see 4.5.7).
- d. Insulation resistance test (see 4.5.3).
- e. Insulation thickness test (see 4.5.3.1).
- f. Wire resistance test (see 4.5.8).

g. Physical properties test (see 4.5.9).

h. High temperature test (see 4.5.10).

4.4.2.1 Rejection and retest. When cable selected from a production run fails to meet the specification, no cable still on hand or produced later shall be accepted until the extent and cause of failure have been determined and appropriately corrected. The contractor shall explain to the Government representative the cause of failure and the action taken to preclude recurrence. After correction, all tests shall be repeated.

4.4.2.1.1 Individual tests may continue. For production reasons, the individual and sampling tests may be continued pending the investigation of a sampling test failure. Final acceptance of cable on hand or produced later shall not be made until it is determined that all cable meets all the requirements of the specification.

4.4.3 Defects in cable already accepted. The investigation of a test failure could indicate that defects may exist in cable already accepted. If so, the contractor shall fully advise the acquiring activity of all defects likely to be found and the method of correcting them.

4.5 Methods of inspection.

4.5.1 Inspection of product. All cable shall be inspected to ascertain compliance with this specification with respect to material, design and construction, workmanship, stranding, and marking.

4.5.2 High potential withstanding voltage test. Each reel of cable shall withstand the high potential specified in table I without failure. The test shall be conducted on final shipping reels of cable. For cable supplied on reels containing short lengths of cable, the test may be conducted on reels used for such tests prior to winding on the shipping reel. The high-voltage tests shall be conducted with an alternating current potential from a transformer and generator of ample capacity, but in no case less than 5 kva. The frequency of the test voltage shall be 60 hertz with a wave shape approximating a sine wave. The initially applied voltage shall be not greater than the rated voltage. The rate of increase shall be approximately uniform and not over 100 percent in 10 seconds nor less than 100 percent in 60 seconds. The reel of cable shall be immersed in a grounded water bath at a temperature of approximately +20 °C for 6 consecutive hours and, while still immersed, it shall be subjected to the test potential. The potential shall be applied between the conductor and ground. The duration of the tests shall be 5 minutes.

4.5.3 Insulation resistance test. Each reel of cable shall be tested in accordance with ICEA S19.81 to determine compliance with the insulation resistance requirements. This test shall be conducted immediately following the test specified in 4.5.2.

4.5.3.1 Insulation thickness test. The average thickness of the insulation shall be determined by measuring the diameter over the insulation and subtracting from it the diameter of the conductor and shield. The difference shall then be divided by two, and the result taken as the thickness of the insulation. Five sets of measurements shall be obtained along the length of a 10-foot sample and the average of the five sets of measurements determined. Each set of measurements shall consist of the determination of the maximum and minimum diameters at the cross-section measured. Measurements shall be made with a micrometer caliper having flat surfaces on both the anvil and end of the spindle, and graduated to read directly in mils, or with a dial micrometer having an anvil, the pressure foot .078 inch wide and .375 inch long, and exerting a force of 10 grams on the pressure foot. If the results of measurement by such methods are in doubt, the optical method shall be used. The optical method utilizes a micrometer microscope accurate to at least .0002 inch (0.01 mm). Measurements of the diameter shall be made at a section halfway between the ends of the sample and at sections 1 inch (25.4 mm) on each side of the midpoint. The average of the maximum and minimum diameters at each section shall be determined, and the lowest of the three averages shall be used as the diameter of the sample in calculating the thickness of the insulation.

4.5.4 Continuity test. Each length of finished cable shall be tested for continuity of the conductor.

4.5.5 Moisture absorption tests. The moisture absorption tests shall be in accordance with part 6 of ICEA S19.81. The test temperature shall be a minimum of 75 °C.

4.5.5.1 Surface resistivity (dc potential). The samples shall be subjected to the tests specified in ICEA S19.81.

4.5.5.2 Surface resistivity (ac potential). Using the same test specimens, similar electrodes spaced 3 inches (76.2 mm) apart shall be attached over the central test section. A 60-cycle ac potential increasing uniformly to 20,000 volts in 20 seconds shall be applied between the electrodes and maintained for 1 minute without flashover or damage to the cable.

4.5.5.3 U-bend discharge. The samples shall be subjected to the tests specified in ICEA S19.81 except that the test potential shall be 150 volts per mil of nominal thickness.

4.5.6 Ozone resistance test. Samples of finished cable shall show no damage after exposure for 3 hours to an ozone concentration of not less than 0.025 percent and not more than 0.030 percent (by volume) according to the ozone-resistance tests specified in ICEA S19.81.

4.5.7 Cold bend test. A sample of the finished cable shall be placed in a cold temperature chamber and maintained at a temperature of -40 °C or below for 24 hours. While still in the cold chamber, the sample shall be given five tight turns around a mandrel whose diameter is five times that of the finished cable. There shall be no visible evidence of cracking. The rate of winding shall be approximately five turns per minute.

4.5.8 Wire resistance test. The resistance of insulated conductor on reels shall be determined at, or the determined resistance corrected to, +20 °C and shall be expressed as resistance per 1,000 feet. The following formula may be used for converting resistance measured at temperatures other than +20 °C to resistances at +20 °C.

$$R_{20} = \frac{254.5R_t}{234.5 + t}$$

Where: R_{20} = Resistance at +20 °C.

R_t = Resistance at temperature (t), in ohms.

t = temperature at which resistance was measured, in degrees centigrade.

4.5.9 Physical properties test. The physical properties shall be tested in accordance with ICEA S19.81 as follows:

- a. Tensile strength (initial and aging).
- b. Elongation (initial and aging).
- c. Modulus (initial).

4.5.10 High temperature test. The high temperature test shall be conducted in accordance with MIL-STD-810, method 501, procedure I. There shall be no evidence of permanent set or insulation deterioration as a result of this test.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2 and 6.4). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. This specification is being retained as a military detail specification because of unique Air Force airport lighting requirements for cross-linked electrical power cable having tin coated conductors. The cable covered by this specification is intended for airport series lighting circuits in direct burial or use on the ground.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Class of cable required (see 1.2).
- c. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2.1 and 2.3).
- d. Length of cable (see 3.7 and 3.7.1).
- e. Inspection conditions, if other than as specified (see 4.2).
- f. Qualification, qualification retention, and requalification procedures, and data requirements (see 3.1, 4.3, and 4.3.4).
- g. If sampling plan is to be other than as specified (see 4.4.2).
- h. Packaging and marking requirements (see 5.1, 6.4, and 6.4.1).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List QPL-38359 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. Upon completion of the qualification inspection (see 4.3), a test report may be prepared as required by the procuring activity (see 6.2). Information pertaining to qualification of products may be obtained from the Defense Supply Center, Columbus (DSCC-VQP), 3990 East Broad Street, Columbus, OH 43213-1199.

6.4 Packaging. MIL-C-12000 has been used in the past to specify requirements for the preservation, packing, unitization, and marking of cable, cord, and wire for storage and domestic and overseas shipments (see 5.1 and 6.2).

6.4.1 Identification of product. Each reel of cable should be marked for identification. In the past, MIL-STD-130 has been used for marking of U. S. military property. The following information should be applied to each reel of cable:

Voltage rating _____
Size of conductor _____
Number of conductors _____
Length (in feet) _____
Serial number _____ (Reel)

6.5 Subject term (key word) listing.

High voltage cable
Underground cable
Environmentally resistant cable
Weather resistant cable

6.6 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

CONCLUDING MATERIAL

Custodians:
Air Force - 11
DLA - CC

Preparing Activity:
DLA - CC

Review Activities:
Air Force - 99

(Project 6145-2277)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7, and send to preparing activity.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:

1. DOCUMENT NUMBER

MIL-DTL-38359B

2. DOCUMENT DATE (YYYYMMDD)

20001110

3. DOCUMENT TITLE

Cables, Power, Electrical, Airport Lighting, Cross-Linked, Polyethylene (XLP)

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle Initial)

b. ORGANIZATION

c. ADDRESS (Include zip code)

d. TELEPHONE (Include Area Code)

(1) Commercial

(2) DSN
(if applicable)

7. DATE SUBMITTED

(YYYYMMDD)

8. PREPARING ACTIVITY

a. NAME Defense Logistics Agency
Defense Supply Center, Columbus (DSCC-VAI)

b. TELEPHONE (Include Area Code)

(1) Commercial: 614-692-0538

(2) DSN: 850-0538

c. ADDRESS (Include Zip Code)

P.O. Box 3990
Columbus, OH 43216-5000

IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:

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